NOW PART OF SPEC.

Table 1

Acc # 1-Vehicle Motion
Acc # 2-Wheel Angle
Light Sensor - Ambient
Temp Sensor - Ambient
Sounder
Mark Button

Table 2

W - Wheel Rotation Angle
X - Measured component of g in sensor axis (m/s/s)
K wheel - Sensor scaling factor (mm/s/s/bit)
g - Gravity 9.81 m/s/s
g - Gravity Vector Component in wheel Plane

$$\text{Sin } W = X / g$$

$$X = k\text{ wheel} / 1000 \times (Ch(1) - ZeroWheel) \times 1/Cos(Alpha)$$

$$\text{Sin } W = k\text{ wheel} / (1000 \times g) \times (Ch(1) - ZeroWheel) \times (1/Cos(Alpha))$$

$$W + ArcSin [Kwheel /(1000 \times g) \times (Ch(1) - ZeroWheel) \times 1/Cos(Alpha)]$$

Table 3

$$\text{RMS Steering Angle - R(Deg)} = \sqrt{\frac{\sum Wheel[n]^2}{n}}$$

Table 4

Bound Check	
W Limit- < W < W Limit+	Steering Mode=Corrective
W < W Limit-	Steering Mode=Active
W > W Limit+	Steering Mode=Active

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Table 5

$$\text{RMS Vehicle Acceleration-G(m/s/s)} = \sqrt{\frac{\sum Acc[n]^2}{n}}$$

Table 6

T cycle = 60s T monitor = 50s T process = 10s	Calculate Parameters Test & Issue Warnings Update Screen Display Store Sensor Data > Disk Store Calculated Parameters > Disk

Table 7

Note:

Data storage @ 1Hz
ZeroAcc=Average {RawAcc[n]}
ZeroWheel=Average {RawWheel[n]}
Ch(N)=Raw ADC Value (bit)

Table 8

$Acc[n] = Kacc/1000 \times (RawAcc[n]-ZeroAcc) \times 1/Cos(Alpha)$

(m/s/s) (mm/s/s/bit)   (bit)   (bit)

$Wheel[n] = ArcSin [Kwheel/(1000 \times 9.81) \times (RawWheel[n]-ZeroWheel) \times 1/Cos(Alpha)]$

(Deg)   (mm/s/s/bit)   (bit)   (bit)

$I = Klight/1000 \times (Ch(2)-ZeroLight)$

(KLx) (Lx/bit)   (bit)   (bit)

$T = Ktemp/1000 \times (Ch(3) - ZeroTemp)$

(DegC) (mDegC/bit) (bit)   (bit)

Table 9

Engineering Scaling Factors	
K acc (mm/s/s/bit)	Acceleration Channel
K wheel (mm/s/s/bit)	Steering Channel
K light (Lx/bit)	Light Channel
K temp (mDegC/bit)	Temp Channel
ZeroLight (bit)	Intercept adjust - Light
ZeroTemp (bit)	Intercept adjust - Temp
Alpha (Deg)	Steering Wheel Inclination from Vertical
Hysterisis (Deg)	Hesterisis factor - Zero X analysis

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Table 10

Sleep Propensity Algorithm - Definition

$$S\ mod = S\ circ + S\ zerox + S\ rms + S\ light + S\ temp + S\ sleep + S\ road + S\ trip$$

Elemental	Bound Limit
$S\ mod$	$0 < S\ mod < 1$
$S\ circ$	$0 < S\ circ < 1$
$S\ zerox = (F\ zerox/100)\ (Z\ ref\text{-}Z)$	$0 < S\ zerox$
$S\ rms = (F\ rms/100)\ (R\text{-}R\ ref)$	$0 < S\ rms$
$S\ light = (F\ light/100)\ (I\ ref\ \text{-}I)$	$0 < S\ light$
$S\ temp = (F\ temp/100)\ (T\ \text{-}T\ ref)$	$0 < S\ temp$
$S\ sleep = (F\ sleep/100)\ (H\ ref\ \text{-}\ (HxQ))$	$0 < S\ sleep$
$S\ road = (F\ road/100)\ (G\ ref\ \text{-}G)$	$0 < S\ road$
$S\ trip = (F\ trip/100)\ x\ D$	$0 < S\ trip$

Table 11

Algorithm Elementals - S	
$S\ mod\ (S)$	Modified Sleep Propensity Factor-Range 0...1
$S\ circ\ (S)$	Current Circadian Sleep Propensity Value
$S\ zerox\ (S)$	Current Corrective Steering Reversal Rate Deficit
$S\ rms\ (S)$	Current RMS Corrective Steering Amplitude Surfit
$S\ light\ (S)$	Current Ambient Lighting Intensity Deficit
$S\ temp\ (S)$	Current Ambient Temperature Surfit
$S\ sleep\ (S)$	Prior Sleep Good Hours Deficit
$S\ road\ (S)$	Current Road Activity Deficit
$S\ trip\ (S)$	Accumulated Trip Duration

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Table 12

Algorithm Weighting Factors - F

Note : Factors are % S Unit per Parameter Unit

F zerox (%S/#/min)	Corrective Steering Reversal Rate Deficit - % Factor
F rms (%S/Deg)	RMS Corrective Steering Amplitude Surfit - % Factor
F light (%S/kLx)	Average Ambient Lighting Intensity Deficit - % Factor
F temp (%S/DegC)	Average Ambient Temperature Surfit - % Factor
F sleep (%S/Hr)	Prior to Good Hours Sleep Deficit - % Factor
F road (%S/m/s/s)	Road Activity Deficit - % Factor
F trip (%S/Hr)	Accumulated Trip Duration - % Factor

Table 13

Algorithm Reference Offfsets - ref

Z ref (#/min)	Corrective Steering Reversal Rate - Ref Offset
	Corresponds to 'Alert ' Driving Subject Dependent
R ref (Deg)	Corrective Steering RMS Amplitude - Ref Offset
	Corresponds to 'Alert ' Driving Subject Dependent
I ref (kLx)	Average Ambient Lighting Intensity - Ref Offset
	Corresponds to moderate daylight
T ref (DegC)	Average Ambient Temperature - Ref Offset
	Corresponds to moderate environment
H ref (Hr)	Prior to Good Hours Sleep - Ref Offset
	Corresponds to optimum value
G ref (m/s/s)	Road Activity - RMS Acceleration / Deceleration - Ref Offset

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Table 14

Algorithm Dynamic Variables	
Z (#/min)	Current Corrective Steering Zero X Rate
R (Deg)	Current RMS Correvtive Steering Amplitude
I (kLx)	Current Ambient Lighting Intensity
T(DegC)	Current Ambient Temperature
G (m/s/s)	Current Road Activity - RMS Acceleration / Deceleration
D(Hr)	Accumulated Trip Duration
H(Hr)	Actual Hours of Prior Sleep
Q (#)	Prior Sleep Quality - Normalised Scale 0...1
Qx (#)	Prior Sleep Quality
	User Scale 1,2,3,4,5
	$Q=Qx/5$

Table 15

Steering Mode & Steering Limit -W limit	
W limit (Deg)	Decision limit - Steering mode detection
	+W limit >W> -W limit >>> Corrective
	+W limit <W< -W limit >>> Active
Steering Mode	Steering mode decision
	ACTIVE. CORRECTIVE

Table 16

Alarm Levels & Alarm State	
Alarm Level 1 (s)	Alarm level threshold
Alarm Level 2 (s)	Alarm level threshold
Alarm Level 3 (s)	Alarm level threshold
Alarm Holdoff (min)	Initial alarm forced hold-off time - N minutes
Alarm State	Alarm status decision
	CLEAR, LEVEL1, LEVEL2, LEVEL3, HOLDOFF

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Table 17

User Software Functions
Set Display Parameters
Enter New Values and <RET> or <RET> to bypass edit option.
Display History (min)   Graphic display history length - Last N minutes
FSD (S)   Graphic display full scale - S unit (0.. 1)

Table 18

Data Directiory Structure

[ALGO] *.ALG
Algorithm Data Files - Internal Format

[USER]*.ALG
User Data Files - Internal Format

[XALGO]*.CSV
Algorithm Data Files - CSV Format

[XUSER]*.CSV
User Data Files - CSV Format

[XDRIVE]*.CSV
Drive Mode Data Files - CSV Format

[XLEARN]*.CSV
Learn Mode Data Files - CSV Format

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Table 19

File Structure - Program Internal Format
Note : These files in program Internal readable format
Configuration File - SLEEPALT.CFG
Save Set Values @ Program Shut Down Load Set Value @ Program Initialisation
K acc   (mm/s/s/bit) K wheel (mm/s/s/bit) K light   (Lx/bit) K temp   (mDegC/bit) K batt   (mV/bit)
ZeroLight   (bit) ZeroTemp   (bit)
Hysterysis   (Deg)
Alpha   (Deg)
AlgorithmID
UserID
Circ[0] ... [23]   (S)
FSD   (0.. 1)
DisplayHist   (min)

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Table 20

Algorithm Data File [ALGO]*.ALG
F zerox   (%S/#/min)
F rms   (%S/Deg)
F light   (%S/Klx)
F temp   (%S/DegC)
F sleep   (%S/Hr)
F road   (%S/m/s/s)
F trip   (%s/Hr)
Z ref   (#/min)
R ref   (Deg)
I ref   (KLx)
T ref   (DegC)
H ref   (Hr)
G ref   (m/s/s)
Alarm1   (s)
Alarm2   (s)
Alarm3   (s)
AlarmHoldoff (min)
W limit (Deg)

Table 21

User Data File [USER]*.USR
UserName
UserDoB
UserSex

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Table 22

> **Data File Structure - Drive Mode Data File [XDRIVE]*.CSV**
> Note: These files in external readable format - CSV
>
> DriveID
> File Ceation Date
> Start Time (Hr 0.. 23)
> Start Time (min 0.. 59)
> UserID
> AlgorithmID
>
> Alarm1 (s)
> Alarm2 (s)
> Alarm3 (s)
> AlarmHoldOff (min)
>
> W limit (Deg)
>
> H (Hr)
> Q (0.. 1)
>
> F zerox (%S/#/min)
> F rms (%S/Deg)
> F light (%S/kLx)
> F temp (%S/DegC)
> F sleep (%S/Hr)
> F road (%S/m/s/s)
> F trip (%S/Hr)
>
> Z ref   (#/min)
> R ref   (Deg)
> I ref   (Kix)
> T ref   (DegC)
> H ref   (Hr)
> G ref   (m/s/s)
>
> Minute Count (min) .... Repeat 1 .. N(min)
> AlarmState
> SteeringMode
> Acceleration [1](m/s/s)   Wheel[1](Deg)
>
> Acceleration [50]   Wheel[50]

Z	(#/min)
R	(Deg)
I	(KLx)
T	(DegC)
G	(m/s/s)
D	(Hr)

> S mod (S)
> S circ (S)
> S zerox (S)
> S rms (S)
> S temp (S)
> S sleep (S)
> S road (S)
> S trip (S)
>
> DQC (Data Quality Code 0..255)

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Table 23

Data File Structure - Learn Mode Data File [XLEARN]*.CSV

Note : These files in external readable format - CSV

Data File Structure - User Data File [XUSER]*.CSV

Note : These files in external readable format - CSV

UserID
File Creation Date

UserName
UserDoB
UserSex

Table 24

> **Data File Structure - Algorithm Data File [XALGO]*.CSV**
>
> Note : These files in external readable format - CSV
>
> AlgorithmID
>
> File Creation Date
>
> F zerox (%S/#/min)
>
> F rms (%S/Deg)
>
> F light (%S/kLx)
>
> F temp (%S/DegC)
>
> F sleep (%S/Hr)
>
> F road (%S/m/s/s)
>
> F trip (%S/Hr)
>
> Z ref   (#/min)
>
> R ref   (Deg)
>
> I ref   (KLx)
>
> T ref   (DegC)
>
> H ref   (Hr)
>
> G ref   (m/s/s)
>
> Alarm1 (s)
>
> Alarm2 (s)
>
> Alarm3 (s)
>
> AlarmHoldOff (min)
>
> W limit (Deg)